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(54) LIMIT POSITION DETECTION DEVICE AND METHOD, AND ACTUATION UNIT USING THE SAME

GRENZPOSITIONDETEKTIONSVORRICHTUNG UND -VERFAHREN UND BETÄTIGUNGSEINHEIT DAMIT

DISPOSITIF ET PROCÉDÉ DE DÉTECTION DE POSITION LIMITE ET UNITÉ D'ACTIONNEMENT FAISANT APPEL À CEUX-CI

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Description

TECHNICAL FIELD

[0001] The present invention relates in general to a device and a method for detecting the reaching of a limit position and an actuation unit using such device and relative method for detecting the reaching of a limit position.

[0002] In particular, the present invention relates to actuation units of the type comprising an actuating member movable between an operative limit position and a non-operative limit position, wherein the detection device is configured to detect the reaching of such limit positions by the movable actuating member.

[0003] Specifically, actuation units of the aforesaid type typically are used in the movement and clamping of metal sheets within the scope of mechanical processing operations, for example to make bodies of motor vehicles. Actuation units in mechanical processing operations indeed are usually equipped with devices for detecting the position of the actuating member, which are suitable for detecting the reaching respectively of the operative and non-operative limit position thereby and for providing a corresponding signal to the control and automation systems of production lines. Such devices for detecting the limit position are also known as _limit position sensors: .

[0004] The actuation units used in making bodies of motor vehicles using a limit position sensor typically are clamping units, power pivots, pin units, gripper units, and also marking units.

[0005] By way of example, the actuating member in clamping units can be identified in the assembly consisting of a pneumatically- or electrically-activated piston rod connected to a fork linkage. Such assembly is movable between two limit positions, thereby resulting in the movement of an articulated lever mechanism that brings a clamping arm into rotation between a closed position and an open position.

BACKGROUND ART

[0006] The actuation units used today in making bodies of motor vehicles typically comprise a limit position sensor that may be external to or at least partially inserted in the body of the actuation unit.

[0007] In the case of at least partially inserted sensor, this may comprise two sensing elements external to the body of the limit position sensor positioned inside the body of the actuation unit at positions in which the detection of the presence of the actuating member is required. Examples of such type of sensors are described in documents DE 9311132, DE 196 16 441 and US 2016/031057. In this case, the actuating member is fixedly connected to triggering components which, by translating therewith, are brought to respective sensing elements of the sensor.

[0008] Alternatively, the sensing elements are integrated in the body of the sensor as described in document DE 10 2013 001 004, which also refers to a sensor partially housed in the body of the actuation unit.

[0009] Also in this case, two triggering components are provided in the body of the actuation unit, the triggering components being moved following the movement of the actuating member in such a manner whereby the triggering components are brought to the respective sensing elements when the actuating member reaches one or the other limit position.

[0010] Similarly, also EP2548700 refers to a sensor with measuring elements integrated in the body of the sensor. Such sensor is positioned at and outside the body of the actuation unit and through a window made on the body of the actuation unit, interacts with triggering components of the sensor moved in the actuation unit following the movement of the actuating member.

[0011] Again, the object of EP3116685 is a sensor with measuring elements integrated in the body of the sensor, and it is completely mounted outside the body of the actuation unit.

[0012] The above-described known solutions make the sensing elements of the limit position sensors according to different technologies, including by way of example, induction technology, Hall effect technology or optical technology.

[0013] In the case of sensing elements of the inductive type, the triggering components each comprise at least one metal part which, when the actuating member reaches the respective limit position, is positioned close to the corresponding sensing element and specifically, at an area in which the sensing element is sensitive, that is able to detect the presence thereof.

[0014] With specific reference to the sensing elements of the inductive type, these traditionally comprise a coil made by means of winding a wire and then inserting it into a ferrite support.

[0015] The A pplicant has found that both such operations result in a variability of the parameters characterizing the coil: the winding process of the wire introduces a variability with reference to the geometry of the resulting coil in terms of distance between the individual turns and accordingly, of overall length of the wire. Moreover, such variability is further increased due to the broad tolerances characterizing ferrite as material. Such variables significantly affect the resulting inductance.

[0016] Moreover, also the fastening of the coil in the ferrite support contributes to increasing the level of variability of the inductance of the resulting coil due to the sizes of the glue disc used for the fastening and the melting position thereof.

[0017] The Applicant has noted that the accuracy on the inductance value of the coil used in making the limit position sensor significantly affects the sensing capacity of the detection device, that is the capacity of discriminating the presence of the metal object.

[0018] The Applicant has also noted that when crossed by a current, the coils traditionally used tend to heat up

and modify the inductance value during the operation thereof, resulting in a variation of the sensitivity area of the sensing element, that is of the sensing field. A similar variation of the sensing capacity occurs in the presence of a significant variation of the environment temperature.

[0019] The Applicant has therefore perceived the need to increase the level of reliability of the known devices for detecting the position of an actuating member movable between an operative limit position and a non-operative limit position.

OBJECTS AND SUMMARY OF THE INVENTION

[0020] In light of that described above, the problem at the basis of the present invention is the one of conceiving a device for detecting the position of an actuating member movable between an operative limit position and a non-operative limit position that has an increased level of repeatability of the features of the inductive sensing elements used and of stability of such features used.

[0021] Within the scope of such problem, it is an object of the present invention to make a device for detecting the position of an actuating member, the sensing elements of which have substantially stable features of inductance with respect to a thermal variation of the sensing elements themselves.

[0022] It is another object of the present invention to make a device for detecting the position of an actuating member that can be made with compact sizes and reduced costs.

[0023] Not lastly, it is an object of the present invention to make a device for detecting the position of an actuating member that can be made by means of an optimized production process and having increased resistance to electromagnetic fields.

[0024] The invention is set forth in independent claims 1 and 10. According to a first aspect thereof, the invention thus relates to a limit position detection device for use in actuation units of the type equipped with an actuating member movable between a first operative limit position and a second non-operative limit position, the device comprising a hollow body inside of which electronic processing means are housed for processing signals detected by at least one sensing element, and at least one sensing element of the inductive type electrically connected to the electronic processing means, wherein the at least one sensing element defines a sensing area within which the sensing element is able to detect at least the partial presence of a triggering component moved due to a translational motion of the actuating member, characterized in that the at least one sensing element comprises at least a first measuring coil-on-chip positioned in such a manner as to detect the presence of a triggering component within the sensing area, and at least one second reference coil-on-chip positioned in such a manner as not to detect the presence of a triggering component within the sensing area.

[0025] The Applicant has identified that it is possible to obviate the variability of the inductance that affects traditional coils thanks to the use of coil-on-chips integrated in a printed circuit. Making coil-on-chips integrated in a printed circuit is indeed characterized by an optimal repeatability, resulting in highly accurate and reliable inductance values.

[0026] However, the Applicant has found that inductance being equal, the coil-on-chips integrated in a printed circuit require significant volumes that are incompatible with the volumes available with reference to the particular application in limit position detection devices of an actuating member of an actuation unit.

[0027] On the other hand, the Applicant has noted that too low inductance values are not capable of generating signal resonance variations caused by the approach of a triggering component that are high enough so as to allow the discrimination thereof with respect to the noise signal.

[0028] Based on the aforesaid observations, the Applicant has devised to introduce a second coil-on-chip integrated on a printed circuit that detects the noise effects attributable to the surrounding environment (for example, the temperature) and to a possible variation of the supply voltage in order to carry out a differential measurement that highlights only inductive effects ascribable to the presence of a triggering component at the sensing area.

[0029] This allows working in a reliable manner also with sufficiently reduced inductance values and accordingly, with coils having sizes compatible with the specific application.

[0030] Such contrivance allows the use of a more stable component that can be increasingly produced in a repeatable manner in compliance with the sizes dictated by the specific application and also while providing an increased measurement accuracy.

[0031] According to a second aspect thereof, the invention relates to an actuation unit comprising:

- a hollow body inside of which an actuating member is housed, linearly movable along an axis between a first operative limit position and a second non-operative limit position,
- a limit position detection device configured to detect the condition of reaching, by the actuating member, of at least one position between the first operative limit position and the second non-operative limit position;

characterized in that the limit position detection device is made as described above.

[0032] Advantageously, the actuation unit according to the invention results in the technical effects described above in relation to the limit position detection device.

[0033] According to a third aspect thereof, the invention relates to a method for detecting the reaching of a limit position by an actuating member linearly movable

along an axis between a first operative limit position and a second non-operative limit position within a body of an actuation unit, the actuating member being coupled to at least one triggering component in such a way that the positioning of the actuating member at at least one between the first operative limit position and the second non-operative limit position corresponds to the positioning of the at least one triggering component at a sensing area of at least one sensing element of a limit position detection device, the method comprising the steps of:

- carrying out a first measurement, through a first measuring coil-on-chip, of the at least one sensing element positioned in such a way as to detect the presence of a triggering component within the sensing area;
- carrying out a second measurement through a second reference coil-on-chip positioned so as not to detect the presence of a triggering component within the sensing area;
- calculating a differential measurement signal on the basis of the first and second measurement carried out;
- monitoring if the differential measurement signal exceeds a predefined threshold value;
- activating a signalling output if the differential measurement signal exceeds the predefined threshold value.

[0034] Advantageously, the method for detecting the reaching of a limit position results in the technical effects described above in relation to the limit position detection device.

[0035] The present invention may have at least one of the following preferred features; the latter may in particular be combined with one another as desired in order to meet specific application needs.

[0036] Preferably, the second reference coil-on-chip is arranged with its axis parallel to the axis of the first measuring coil-on-chip and spaced apart from the same veering away from the area of measurement.

[0037] More preferably, the second reference coil-on-chip is arranged coaxially with respect to the first measuring coil-on-chip and is spaced apart from the same along an axial direction veering away from the sensing area.

[0038] Even more preferably, the second reference coil-on-chip is spaced apart from the first measuring coil-on-chip by at least 2 mm, along an axial direction.

[0039] Alternatively or in addition, at least one element made of shielding material is interposed between the first and the second coil-on-chip.

[0040] Preferably, the shielding material is copper clad laminate.

[0041] With copper clad laminate reference is made to a fiberglass panel covered by thin metal foil.

[0042] Preferably, the first measuring coil-on-chip of the at least one sensing element is contained inside the hollow body.

[0043] Alternatively, the first measuring coil-on-chip of the at least one sensing element is arranged outside the hollow body and is electrically connected to the electronic processing means through at least one electrical conductor and/ or an electric path.

[0044] According to a further alternative, the first measuring coil-on-chip of the at least one sensing element is arranged outside the hollow body and is electrically connectable to the electronic processing means through at least one electrical connector.

[0045] Preferably, the second reference coil-on-chip is contained inside the hollow body.

[0046] Alternatively, the second reference coil-on-chip is arranged outside the hollow body and is electrically connected to the electronic processing means through at least one electrical conductor and/ or an electric path.

[0047] According to a further alternative, the second reference coil-on-chip is arranged outside the hollow body and is electrically connectable to the electronic processing means through at least one electrical connector.

[0048] Preferably, there are provided two sensing elements, each comprising at least one measuring coil, a first sensing element defining a first sensing area that can be reached by a first triggering component when the actuating member reaches the first limit position, and a second sensing element defining a second sensing area that can be reached by a second triggering component when the actuating member reaches the second limit position.

[0049] More preferably, each sensing element is associated with a different reference coil.

[0050] A Iternatively, each sensing element is associated with the same reference coil.

[0051] Preferably, the actuating member is coupled to at least one triggering component in such a way that the positioning of the actuating member at at least one between the first operative limit position and the second non-operative limit position corresponds to the positioning of the at least one triggering component at the sensing area of the at least one sensing element.

[0052] More preferably, the triggering component is a metal part brought into translational motion by the actuating member.

[0053] Alternatively, the triggering component comprises a lever coupled in movement to the actuating member and carrying at least one metal part.

[0054] Preferably, the hollow body comprises at least one opening through which the positioning of the at least one triggering component at the sensing area of the at least one sensing element, can be detected, the limit position detection device being constrained to and outside the hollow body at the opening.

[0055] More preferably, the at least one opening is sealed though non-magnetic material.

[0056] Alternatively, the hollow body comprises at least one opening for the at least partial insertion of the at least one triggering component into the hollow body.

[0057] Preferably, the actuating member comprises a piston rod connected to a fork linkage, the actuating member acting on an articulated lever for actuating the rotation of an actuation arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] Further features and advantages of the present invention will be more evident from the following detailed description of certain preferred embodiments thereof made with reference to the appended drawings.

[0059] The different features in the individual configurations may be combined with one another as desired according to the preceding description, should there be advantages specifically resulting from a specific combination.

[0060] In such drawings:

- figure 1 is a perspective view of an actuation unit and of a limit position detection device according to a first preferred embodiment of the present invention;
- figure 2 is a plan view of the limit position detection device in figure 1;
- figure 3 is a partial cut-out side elevated view of the actuation unit and of the limit position detection device in figure 1, wherein the actuation arm is not depicted for clarity of illustration;
- figure 4 is an enlarged detail of figure 3;
- figure 5 is a side elevated view of a limit position detection device according to a second preferred embodiment of the present invention;
- figure 6 is a perspective view of a limit position detection device according to a third preferred embodiment of the present invention;
- figure 7 is a block diagram of the method for detecting the reaching of a limit position according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0061] For the illustration of the drawings, use is made in the following description of identical numerals or symbols to indicate construction elements with the same function. Moreover, for clarity of illustration, certain references may not be repeated in all drawings.

[0062] While the invention is susceptible to various modifications and alternative constructions, certain preferred embodiments are shown in the drawings and are described hereinbelow in detail. It is in any case to be noted that there is no intention to limit the invention to the specific embodiment illustrated rather on the contrary, the invention intends covering all the modifications, alternative and equivalent constructions that fall within the scope of the invention as defined in the claims.

[0063] The use of _for example:, _etc.:, _or: indicates non-exclusive alternatives without limitation, unless otherwise indicated. The use of _comprises: and _includes: means _comprises or includes, but not limited to:, unless otherwise indicated.

[0064] With reference to figure 1, there is illustrated a first preferred embodiment of an actuation unit 50 and of a limit position detection device 10 according to the present invention. The actuation unit 50 in figure 1 is a clamping unit.

[0065] As shown in figure 3, the clamping unit 50 comprises a hollow body 51 inside of which there is arranged an actuating member 52, wherein in the specific case illustrated, the actuating member comprises a piston rod connected to a fork linkage. The actuating member 52 acts on an articulated lever 53 to actuate the rotation of an actuation arm 54, for example a clamping element.

[0066] The actuating member 52 is linearly movable along an axis A, between a first operative limit position 55 shown in figure 3, and a second non-operative limit position (not illustrated), corresponding respectively to an angular closed position and an angular open position of the clamping element 54.

[0067] The clamping unit 50 comprises a limit position detection device 10 configured to detect the positioning of the actuating member 52 at each of the limit positions.

[0068] Specifically, the limit position detection device 10 in figures 1 and 3 is mounted to and outside the hollow body 51 and comprises two sensing elements 11, 12 of the inductive type that are completely contained inside a body 13 of the device 10 itself. In particular, the sensing elements 11, 12 are positioned in such a manner as to face two respective openings 56 made in the body 51 of the clamping unit 50 and sealed with a non-magnetic material 57, for example an acrylic material.

[0069] Two sensing areas for the detection device 10 are thus defined at the two openings 56, that is areas within which the respective sensing element 11, 12 is sensitive to the presence of a metal part, namely it is able to detect the presence thereof.

[0070] As shown in figure 3, the actuating member 52 is coupled to two triggering components 57a, 57b which each carry a metal part 58a, 58b at the end thereof in such a manner as to bring the metal part 58a of a first triggering component 57a at a first sensing area when the actuating member 52 is in the first limit position, and the metal part 58b of a second triggering component 57b at a second sensing area when the actuating member 52 is in the second limit position.

[0071] With reference to figure 2, the limit position detection device 10 comprises a connector 14 connected

to the body 13 of the device and three signaling lights 15 configured to signal the status of the actuating member 52 detected by the sensing elements 11, 12 of the device 10.

[0072] According to the present invention, each inductive type sensing element 11, 12 of the limit position detection device 10 comprises a measuring coil-on-chip 16 integrated directly on a printed circuit 17 of the detection device 10. The printed circuit 17 also implements electronic processing means for processing signals detected by the sensing elements 11, 12.

[0073] In particular, in the preferred embodiment illustrated, each sensing element 11, 12 is associated with a second coil-on-chip 19 integrated on a printed circuit which acts as measuring reference in order to detect all the signal disturbances introduced from the environment in which the measurement is carried out.

[0074] In the embodiment in figure 2 and 4, all the coil-on-chips 16, 19 are positioned inside the body 13 of the detection device and specifically, the measuring coils 16 are placed in such a manner as to detect the presence of a triggering component 57a, 58a, 57b, 58b within the relative sensing area, while the reference coils 19 are positioned in such a manner as not to detect the presence of the triggering component 57a, 58a, 57b, 58b within such sensing area.

[0075] In particular, as illustrated in figure 4, each reference coil 19 is coaxial to the respective measuring coil 16 and is spaced apart from it along an axial direction veering away from the sensing area. Specifically in the embodiment illustrated, the measuring 16 and reference coils 19 are spaced apart by 2 mm, with interposition of the electronic board 17 in which they are integrated.

[0076] Figure 5 shows a second embodiment of the limit position detection device 10' in which the sensing elements 11, 12 are made external to the body 13 of the device, while there is provided a reference coil (not shown in figure 5) positioned inside the body 13 of the detection device.

[0077] Also in this case, each sensing element 11, 12 comprises a measuring coil-on-chip 16 integrated in a printed circuit 17 with which the reference coil-on-chip placed inside the hollow body 13 is associated as reference for a differential measurement.

[0078] The sensing elements 11, 12 are connected to electronic processing means by means of electrical connections 18 for processing the signals detected by the sensing elements 11, 12 implemented by means of a printed circuit (not illustrated) inside the body 13 of the device in which the reference coil-on-chip is integrated.

[0079] The limit position detection device 10' in figure 5 is of the type that can be partially inserted into the body 52 of an actuation unit 50, wherein the sensing elements 11, 12 are designed to be inserted into the body 52 and the body 13 of the device is designed to overlap an opening made on the body 52 of the actuation unit 50, thus closing it.

[0080] Figure 6 shows a third embodiment of the limit position detection device 10" in which the sensing elements 11, 12 are made outside the body 13 of the device.

[0081] Unlike the second embodiment, the sensing elements 11, 12 in the detection device 10" in figure 6 are carried by a support plate 20 that can be constrained in an overhanging manner to the body 13 of the device.

[0082] Although they are not expressly illustrated, two second reference coils are arranged behind the support plate 20, each at a respective first measuring coil 16 of the sensing elements 11, 12.

[0083] In particular, it is possible to fasten the support plate 20 inside an actuation unit 50 and to electrically connect the measuring 16 and reference coil-on-chips 19 placed on the plate 20 to the electronic processing means contained inside the body 13 of the detection device by means of suitable electrical connections, which in the specific case in figure 6, comprise electric paths and two weld spots 21.

[0084] In alternative embodiments (not illustrated), in a completely equivalent manner it is possible to provide an electrical connector or a plurality of electrical conductors in place of the weld spots 21.

[0085] Also in this case, the limit position detection device 10" in figure 6 is of the type that can be partially inserted into the body 52 of an actuation unit 50, with the support plate 20 possibly already inserted and fastened inside the body 52 of the unit and the body 13 of the device overlapping an opening made on such body 52 of the actuation unit 50, thus closing it.

[0086] The method 100 for detecting the reaching of a limit position implemented by the limit position detection device 10, 10', 10" is the following.

[0087] In order to detect the proximity of a metal part 58a, 58b carried by a triggering component 57a, 57b with respect to a measuring element 11, 12, the amplitude of the voltage at the ends of each resonant circuit to which the measuring coil-on-chip 16 of the respective measuring element 11, 12 belongs, is monitored (step 110).

[0088] The amplitude of the voltage at the ends of the resonant circuit to which the reference coil-on-chip 19 belongs is simultaneously detected (step 120).

[0089] Based on the amplitude values detected, a differential measurement signal is calculated (step 130) and monitored (step 140) if the differential measurement signal exceeds (in positive or in negative) a predetermined threshold value indicating the presence of a metal part at the sensitivity area of the respective measuring element 11, 12.

[0090] Should the differential measurement signal exceed the predetermined threshold value, a signalling output (step 150) is activated at the control and automation systems of the production lines and/ or an activation signal of signalling means 15 is generated indicating the reaching of the limit position.

Claims

1. Limit position detection device (10) for use in actuation units (50) of the type equipped with an actuating member (52) movable along an axis (A) between a first operative limit position (55) and a second, non-operative limit position, within a body (51) of an actuation unit (50), the device (10) comprising a hollow body (13) inside of which electronic processing means are housed for processing signals detected by at least one sensing element (11, 12), the at least one sensing element (11,12) of the inductive type electrically connected to the electronic processing means, wherein the at least one sensing element (11,12) defines a sensing area inside of which the sensing element (11,12) is able to detect at least the partial presence of at least one triggering component (57a,58a,57b,58b) moved due to a translational motion of the actuating member (52), **characterized in that** the at least one sensing element (11,12) comprises at least one first measuring coil-on-chip (16) positioned such as to detect the presence of the at least one triggering component (57a,58a,57b,58b) within the sensing area and provide a corresponding first measurement, and at least one second reference coil-on-chip (19) positioned in such a way as not to detect the presence of the at least one triggering component (57a,58a,57b,58b) within the sensing area and provide a corresponding second measurement for calculating a differential measurement signal with respect to the first measurement.

2. Limit position detection device (10) according to claim 1, wherein the at least one second reference coil-on-chip (19) is arranged with its axis parallel to the axis of the at least one first measuring coil-on-chip (16) and spaced apart from the same veering away from the area of measurement.

3. Limit position detection device (10) according to claim 2, wherein the at least one second reference coil-on-chip (19) is arranged coaxially with respect to the at least one first measuring coil-on-chip (16) and spaced apart from the same along an axial direction.

4. Limit position detection device (10) according to any one of the preceding claims, wherein between the at least one first (16) and the at least one second (19) coil-on-chip at least one element made of shielding material is interposed.

5. Limit position detection device (10) according to any one of the preceding claims, wherein the at least one first measuring coil-on-chip (16) of the at least one sensing element (11,12) and/or the at least one second reference coil-on-chip (19) is housed inside of the hollow body (13).

6. Actuation unit (50) comprising:

   - a hollow body (51) inside of which an actuating member (52) is housed, linearly movable along an axis (A) between a first operative limit position and a second, non-operative limit position,
   - a limit position detection device (10) configured to detect the condition of reaching by the actuating member (52) of at least one position between the first operative limit position (55) and the second non-operative limit position;

   characterized in that limit position detection device (10) is made according to any one of the preceding claims.

7. Actuation unit (50) according to claim 6, wherein the actuating member (52) is coupled to at least one triggering component (57a,57b,58a,58b) in such a way that the positioning of the actuating member (52) at at least one between the first operative limit position (55) and the second non-operative limit position corresponds to the positioning of the at least one triggering component (57a,57b,58a,58b) at the sensing area of the at least one sensing element (11,12).

8. Actuation unit (50) according to claim 7, wherein the hollow body (51) comprises at least one opening (56) through which the positioning of the at least one triggering component (57a, 57b, 58a, 58b) at the sensing area of the at least one sensing element (11, 12) can be detected, the limit position detection device (10) being constrained to and outside the hollow body (51) at the opening (56).

9. Actuation unit (50) according to any one of the claims from 6 to 8, wherein the actuating member (52) comprises a piston rod connected to a fork linkage, the actuating member (52) acting on an articulated lever (53) for actuating the rotation of an actuation arm (54).

10. Method (100) for detecting the reaching of a limit position by an actuating member (52) linearly movable along an axis (A) between a first operative limit position (55) and a second, non-operative limit position within a body (51) of an actuation unit (50), the actuating member (52) being coupled to at least one triggering component (57a,57b,58a,58b) in such a way that the positioning of the actuating member (52) at at least one between the first operative limit position (55) and the second non-operative limit position corresponds to the positioning of the at least one triggering component (57a,57b,58a,58b) at a sensing area of at least one sensing element (11,12), the at least one sensing element (11,12) of the inductive type electrically connected to electronic processing means of a limit position detection device (10), the

method **characterised in that** the method comprises the steps of:

- carrying out a first measurement (110) through a first measuring coil-on-chip (16) of the at least one sensing element (11,12) positioned in such a way as to detect the presence of the at least one triggering component (57a,58a,57b,58b) within the sensing area;
- carrying out a second measurement (120) through a second reference coil-on-chip (19) positioned so as not to detect the presence of the at least one triggering component (57a,58a,57b,58b) within the sensing area;
- calculating (130) a differential measurement signal on the basis of the first and second measurement carried out;
- monitoring (140) if the differential measurement signal exceeds a predefined threshold value;
- activating (150) a signalling output if the differential measurement signal exceeds the predetermined threshold value.

Patentansprüche

1. Endpositionserkennungsvorrichtung (10) zur Verwendung in Betätigungseinheiten (50) des Typs, der mit einem Betätigungselement (52) ausgestattet ist, das entlang einer Achse (A) zwischen einer ersten wirksamen Endposition (55) und einer zweiten, nicht wirksamen Endposition innerhalb eines Körpers (51) einer Betätigungseinheit (50) bewegbar ist, wobei die Vorrichtung (10) einen hohlen Körper (13) umfasst, in dessen Innerem elektronische Verarbeitungsmittel zur Verarbeitung von Signalen untergebracht sind, die von mindestens einem Sensorelement (11, 12) erfasst werden, wobei mindestens ein Sensorelement (11, 12) des induktiven Typs elektrisch mit den elektronischen Verarbeitungsmitteln verbunden ist, wobei das mindestens eine Sensorelement (11, 12) einen Sensorbereich definiert, innerhalb dessen das Sensorelement (11, 12) in der Lage ist, mindestens das teilweise Vorhandensein von mindestens einer Auslösekomponente (57a, 58a, 57b, 58b) zu erkennen, die aufgrund einer Translationsbewegung des Betätigungselements (52) bewegt wird, **dadurch gekennzeichnet, dass** das mindestens eine Sensorelement (11, 12) mindestens eine erste Messspule auf einem Chip (coil-on-chip) (16), die so positioniert ist, dass sie die Anwesenheit der mindestens einen Auslösekomponente (57a, 58a, 57b, 58b) innerhalb des Erfassungsbereichs erkennt und eine entsprechende erste Messung liefert, und mindestens eine zweite Referenzspule auf einem Chip (coil-on-chip) (19) umfasst, die so positioniert ist, dass sie das Vorhandensein der mindestens einen Auslösekomponente (57a, 58a, 57b, 58b) innerhalb des Erfassungsbereichs nicht erkennt und eine entsprechende zweite Messung zum Berechnen eines Differenzmesssignals in Bezug auf die erste Messung liefert.

2. Endpositionserkennungsvorrichtung (10) nach Anspruch 1, wobei die mindestens eine zweite Referenzspule auf dem Chip (coil-on-chip) (19) mit ihrer Achse parallel zur Achse der mindestens einen ersten Messspule auf dem Chip (coil-on-chip) (16) und beabstandet von dieser vom Messbereich wegdrehend angeordnet ist.

3. Endpositionserkennungsvorrichtung (10) nach Anspruch 2, wobei die mindestens eine zweite Referenzspule auf dem Chip (coil-on-chip) (19) koaxial zu der mindestens einen ersten Messspule auf dem Chip (coil-on-chip) (16) und entlang einer axialen Richtung beabstandet zu dieser angeordnet ist.

4. Endpositionserkennungsvorrichtung (10) nach einem der vorhergehenden Ansprüche, wobei zwischen der mindestens einen ersten (16) und der mindestens einen zweiten (19) Spule auf dem Chip (coil-on-chip) mindestens ein Element aus Abschirmungsmaterial zwischengeschaltet ist.

5. Endpositionserkennungsvorrichtung (10) nach einem der vorhergehenden Ansprüche, wobei die mindestens eine erste Messspule auf dem Chip (coil-on-chip) (16) des mindestens einen Sensorelements (11, 12) und/oder die mindestens eine zweite Referenzspule auf dem Chip (coil-on-chip) (19) im Inneren des Hohlkörpers (13) angeordnet ist.

6. Betätigungseinheit (50) umfassend:

- einen Hohlkörper (51), in dessen Inneren ein Betätigungselement (52) angeordnet ist, das linear entlang einer Achse (A) zwischen einer ersten wirksamen Endposition und einer zweiten, nicht wirksamen Endposition bewegbar ist,
- eine Endpositionserkennungsvorrichtung (10), die derart konfiguriert ist, dass sie den Zustand des Erreichens mindestens einer Position zwischen der ersten wirksamen Endposition (55) und der zweiten nicht wirksamen Endposition durch das Betätigungselement (52) erfasst;

dadurch gekennzeichnet, dass die Endpositionserkennungsvorrichtung (10) nach einem der vorhergehenden Ansprüche hergestellt ist.

7. Betätigungseinheit (50) nach Anspruch 6, wobei das Betätigungselement (52) mit mindestens einer Auslösekomponente (57a, 57b, 58a, 58b) derart gekoppelt ist, dass die Positionierung des Betätigungsele-

ments (52) an mindestens einer zwischen der ersten wirksamen Endposition (55) und der zweiten nicht wirksamen Endposition der Positionierung der mindestens einen Auslösekomponente (57a, 57b, 58a, 58b) am Erfassungsbereich des mindestens einen Sensorelements (11, 12) entspricht.

8. Betätigungseinheit (50) nach Anspruch 7, wobei der Hohlkörper (51) mindestens eine Öffnung (56) aufweist, durch die hindurch die Positionierung der mindestens einen Auslösekomponente (57a, 57b, 58a, 58b) an dem Erfassungsbereich des mindestens einen Sensorelements (11, 12) detektiert werden kann, wobei die Endpositionserkennungsvorrichtung (10) an und außerhalb des Hohlkörpers (51) an der Öffnung (56) gehalten ist.

9. Betätigungseinheit (50) nach einem der Ansprüche 6 bis 8, wobei das Betätigungselement (52) eine mit einem Gabelgestänge verbundene Kolbenstange aufweist, wobei das Betätigungselement (52) auf einen Gelenkhebel (53) zur Betätigung der Drehung eines Betätigungsarms (54) wirkt.

10. Verfahren (100) zum Erfassen des Erreichens einer Endposition durch ein entlang einer Achse (A) zwischen einer ersten wirksamen Endposition (55) und einer zweiten, nicht wirksamen Endposition innerhalb eines Körpers (51) einer Betätigungseinheit (50) linear bewegbares Betätigungselement (52), wobei das Betätigungselement (52) mit mindestens einer Auslösekomponente (57a, 57b, 58a, 58b) derart gekoppelt ist, dass die Positionierung des Betätigungselements (52) an mindestens einer zwischen der ersten wirksamen Endposition (55) und der zweiten nicht wirksamen Endposition der Positionierung der mindestens einen Auslösekomponente (57a, 57b, 58a, 58b) in einem Erfassungsbereich des mindestens eines Sensorelements (11, 12) entspricht, wobei das mindestens eine Sensorelement (11, 12) vom induktiven Typ elektrisch mit elektronischen Verarbeitungsmitteln einer Endpositionserkennungsvorrichtung (10) verbunden ist, wobei das Verfahren **dadurch gekennzeichnet ist, dass** das Verfahren die folgenden Schritte umfasst:

- Ausführen einer ersten Messung (110) durch eine erste Messspule auf dem Chip (coil-on-chip) (16) des mindestens einen Sensorelements (11, 12), die derart positioniert ist, dass sie das Vorhandensein der mindestens einen Auslösekomponente (57a, 58a, 57b, 58b) innerhalb des Sensorbereichs erfasst;
- Ausführen einer zweiten Messung (120) durch eine zweite Referenzspule auf dem Chip (coil-on-chip) (19), die so positioniert ist, dass sie das Vorhandensein der mindestens einen Auslösekomponente (57a, 58a, 57b, 58b) innerhalb des Erfassungsbereichs nicht erfasst;
- Berechnen (130) eines Differenzmesssignals auf der Basis der ersten und zweiten durchgeführten Messung;
- Überwachung (140), wenn das Differenzmesssignal einen vordefinierten Schwellwert überschreitet;
- Aktivieren (150) eines Signalausgangs, wenn das Differenzmesssignal den vorgegebenen Schwellenwert überschreitet.

Revendications

1. Dispositif de détection de position limite (10) destiné à être utilisé dans des unités d'actionnement (50) du type équipé d'un élément d'actionnement (52) mobile le long d'un axe (A) entre une première position limite fonctionnelle (55) et une seconde position limite, non-fonctionnelle, à l'intérieur d'un corps (51) d'une unité d'actionnement (50), le dispositif (10) comprenant un corps creux (13) à l'intérieur duquel des moyens de traitement électroniques sont reçus pour traiter des signaux détectés par au moins un élément de détection (11, 12), l'au moins un élément de détection (11, 12) du type inductif étant relié électriquement aux moyens de traitement électroniques, l'au moins un élément de détection (11, 12) définissant une zone de détection à l'intérieur de laquelle l'élément de détection (11, 12) est capable de détecter au moins la présence partielle d'au moins un composant de déclenchement (57a, 58a, 57b, 58b) déplacé en raison d'un mouvement de translation de l'élément d'actionnement (52), **caractérisé par le fait que** l'au moins un élément de détection (11, 12) comprend au moins une première bobine sur puce de mesure (16) positionnée de façon à détecter la présence de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à l'intérieur de la zone de détection et à fournir une première mesure correspondante, et au moins une seconde bobine sur puce de référence (19) positionnée de façon à ne pas détecter la présence de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à l'intérieur de la zone de détection et à fournir une seconde mesure correspondante pour calculer un signal de mesure différentiel par rapport à la première mesure.

2. Dispositif de détection de position limite (10) selon la revendication 1, dans lequel l'au moins une seconde bobine sur puce de référence (19) est disposée avec son axe parallèle à l'axe de l'au moins une première bobine sur puce de mesure (16) et espacée de celle-ci en s'éloignant de la zone de mesure.

3. Dispositif de détection de position limite (10) selon la revendication 2, dans lequel l'au moins une se-

conde bobine sur puce de référence (19) est disposée coaxialement par rapport à l'au moins une première bobine sur puce de mesure (16) et espacée de celle-ci le long d'une direction axiale.

4. Dispositif de détection de position limite (10) selon l'une quelconque des revendications précédentes, dans lequel, entre l'au moins une première bobine sur puce (16) et l'au moins une seconde bobine sur puce (19), est interposé au moins un élément fait de matériau de protection.

5. Dispositif de détection de position limite (10) selon l'une quelconque des revendications précédentes, dans lequel l'au moins une première bobine sur puce de mesure (16) de l'au moins un élément de détection (11, 12) et/ou l'au moins une seconde bobine sur puce de référence (19) est reçue à l'intérieur du corps creux (13).

6. Unité d'actionnement (50) comprenant :

- un corps creux (51) à l'intérieur duquel un élément d'actionnement (52) est reçu, mobile de manière linéaire le long d'un axe (A) entre une première position limite fonctionnelle et une seconde position limite, non-fonctionnelle,
- un dispositif de détection de position limite (10) configuré pour détecter la condition d'atteinte, par l'élément d'actionnement (52), d'au moins une position entre la première position limite fonctionnelle (55) et la seconde position limite non-fonctionnelle ;

caractérisée par le fait que le dispositif de détection de position limite (10) est réalisé selon l'une quelconque des revendications précédentes.

7. Unité d'actionnement (50) selon la revendication 6, dans laquelle l'élément d'actionnement (52) est couplé à au moins un composant de déclenchement (57a, 58a, 57b, 58b) de telle sorte que le positionnement de l'élément d'actionnement (52) à au moins une entre la première position limite fonctionnelle (55) et la seconde position limite non-fonctionnelle correspond au positionnement de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à la zone de détection de l'au moins un élément de détection (11, 12).

8. Unité d'actionnement (50) selon la revendication 7, dans laquelle le corps creux (51) comprend au moins une ouverture (56) à travers laquelle le positionnement de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à la zone de détection de l'au moins un élément de détection (11, 12) peut être détecté, le dispositif de détection de position limite (10) étant contraint au et à l'extérieur du corps creux (51) au niveau de l'ouverture (56).

9. Unité d'actionnement (50) selon l'une quelconque des revendications 6 à 8, dans laquelle l'élément d'actionnement (52) comprend une tige de piston reliée à une liaison en fourche, l'élément d'actionnement (52) agissant sur un levier articulé (53) pour actionner la rotation d'un bras d'actionnement (54).

10. Procédé (100) pour détecter l'atteinte d'une position limite par un élément d'actionnement (52) mobile de manière linéaire le long d'un axe (A) entre une première position limite fonctionnelle (55) et une seconde position limite, non-fonctionnelle, à l'intérieur d'un corps (51) d'une unité d'actionnement (50), l'élément d'actionnement (52) étant couplé à au moins un composant de déclenchement (57a, 58a, 57b, 58b) de telle sorte que le positionnement de l'élément d'actionnement (52) à au moins une entre la première position limite fonctionnelle (55) et la seconde position limite non-fonctionnelle correspond au positionnement de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à une zone de détection d'au moins un élément de détection (11, 12), l'au moins un élément de détection (11, 12) du type inductif étant relié électriquement à des moyens de traitement électroniques d'un dispositif de détection de position limite (10), le procédé étant **caractérisé par le fait que** le procédé comprend les étapes :

- réaliser une première mesure (110) par l'intermédiaire d'une première bobine sur puce de mesure (16) de l'au moins un élément de détection (11, 12) positionnée de façon à détecter la présence de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à l'intérieur de la zone de détection ;
- réaliser une seconde mesure (120) par l'intermédiaire d'une seconde bobine sur puce de référence (19) positionnée de façon à ne pas détecter la présence de l'au moins un composant de déclenchement (57a, 58a, 57b, 58b) à l'intérieur de la zone de détection ;
- calculer (130) un signal de mesure différentiel sur la base des première et seconde mesures réalisées ;
- surveiller (140) si le signal de mesure différentiel dépasse une valeur de seuil prédéfinie ;
- activer (150) une sortie de signalisation si le signal de mesure différentiel dépasse la valeur de seuil prédéterminée.

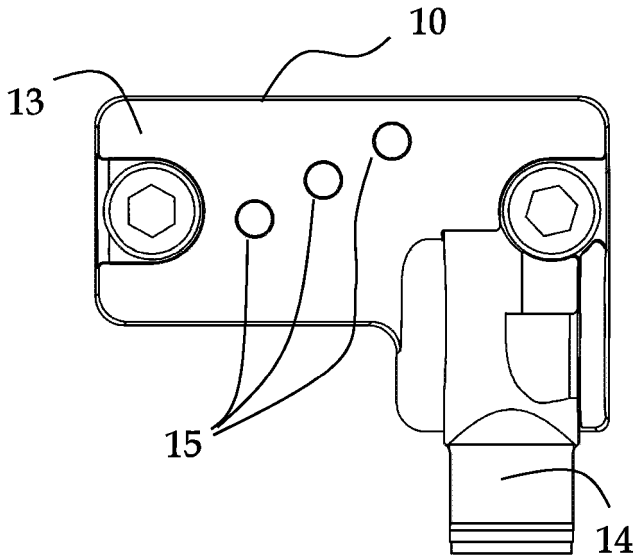

FIG. 2

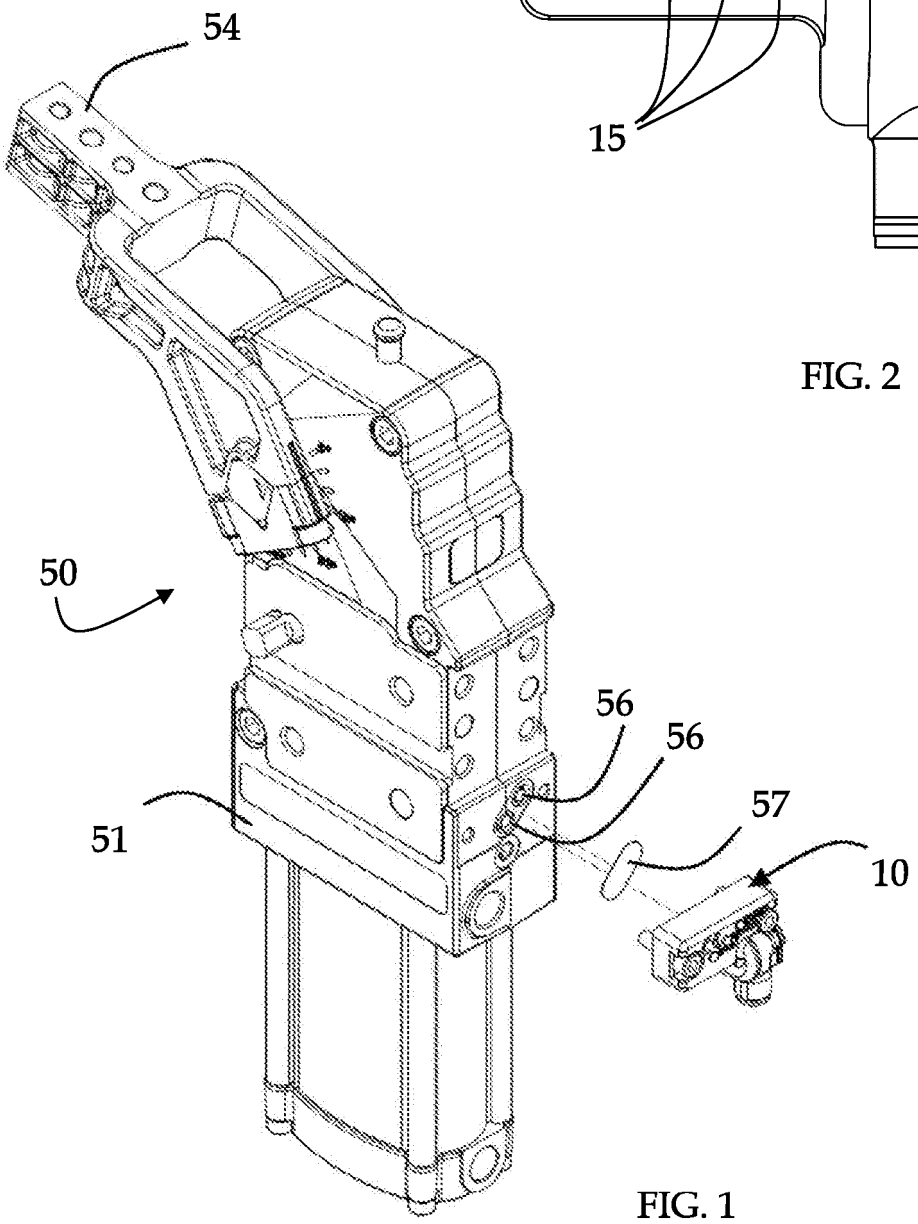

FIG. 1

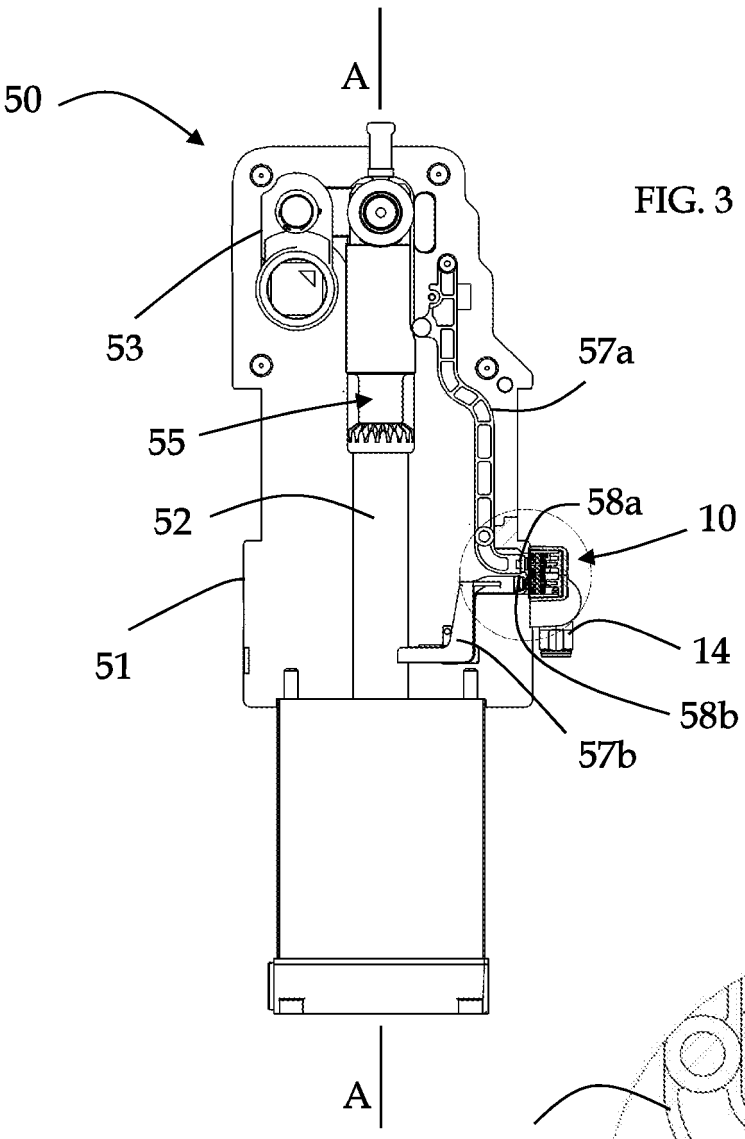
A
50
53
57a
55
52
58a
10
51
14
58b
57b
A

FIG. 3

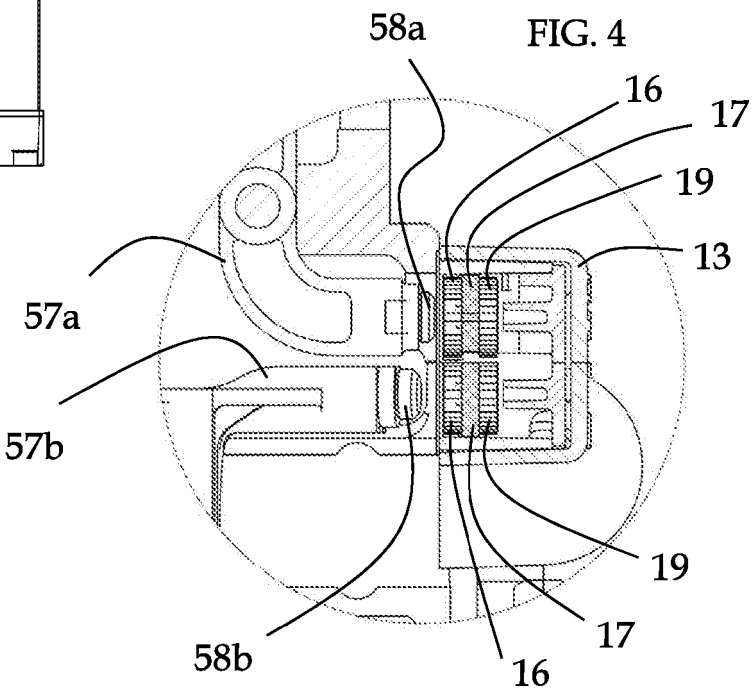
58a
16
17
19
13
57a
57b
19
17
58b
16

FIG. 4

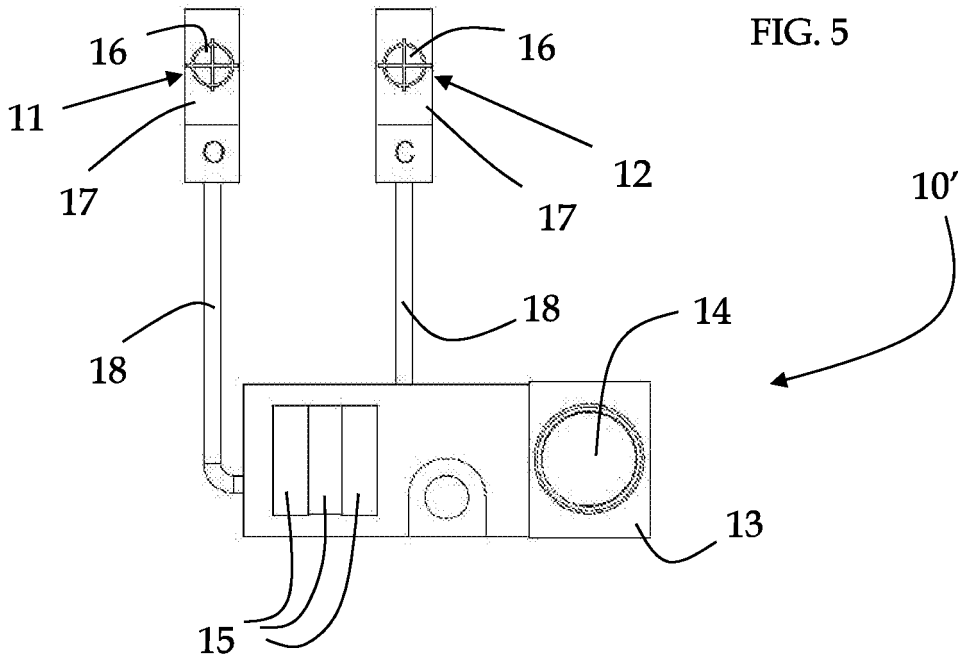

FIG. 5

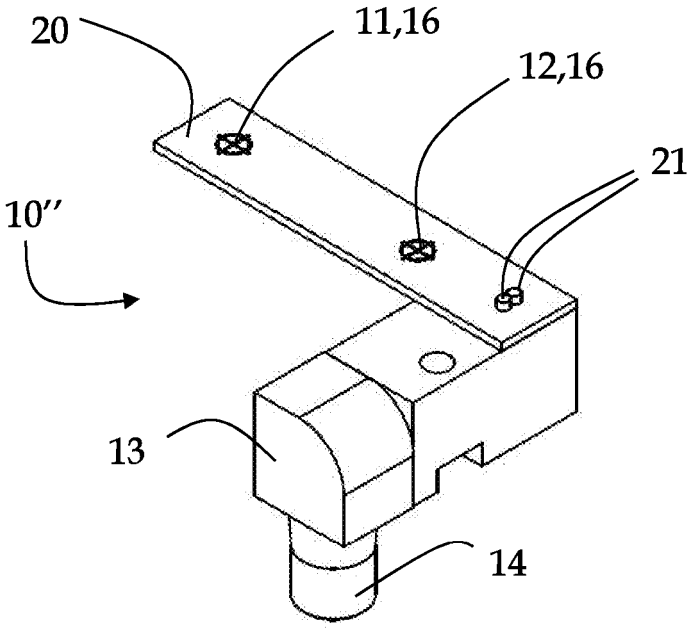

FIG. 6

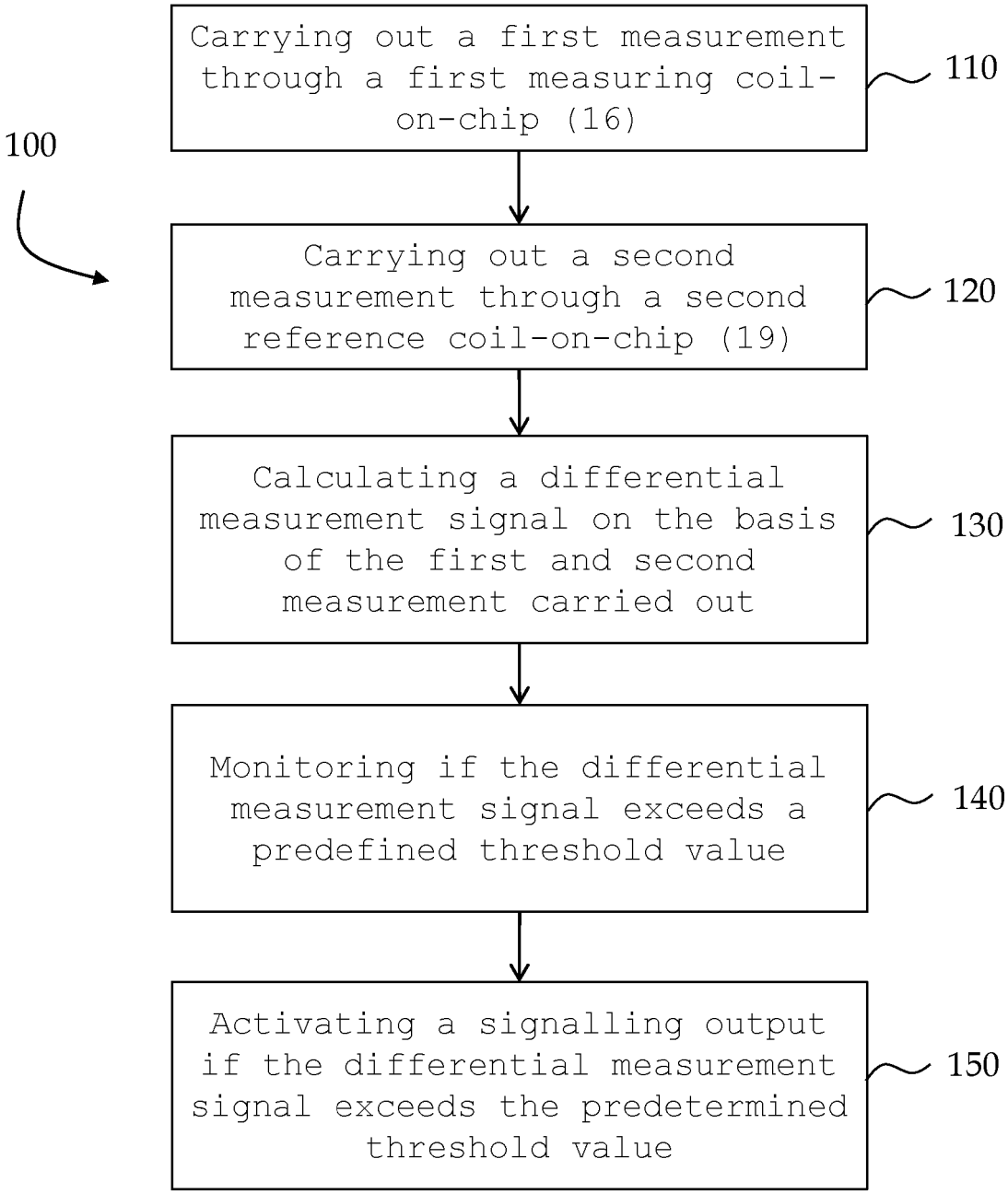
100
Carrying out a first measurement through a first measuring coil-on-chip (16)
110
Carrying out a second measurement through a second reference coil-on-chip (19)
120
Calculating a differential measurement signal on the basis of the first and second measurement carried out
130
Monitoring if the differential measurement signal exceeds a predefined threshold value
140
Activating a signalling output if the differential measurement signal exceeds the predetermined threshold value
150

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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